PATENT ABSTRACTS OF JAPAN

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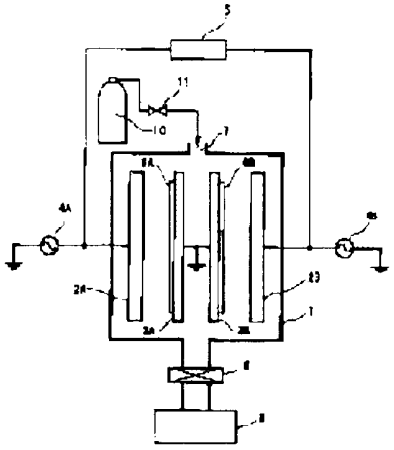
(54) ELECTRONIC DEVICE MANUFACTURING APPARATUS AND METHOD THEREFOR

(57)Abstract:
PROBLEM TO BE SOLVED: To enable high-frequency electric powers to be applied to each of two pairs of electrodes installed in a vacuum vessel, without making plasma interfere with each other.
SOLUTION: A vacuum vessel 1, equipped with a first pair of electrodes 2A and 3A and a second pair of electrodes 2B and 3B inside, a gas inlet 7 through which material gas in introduced into the vacuum vessel 1, and a first and a second power supply 4A and 4B, which apply pulse-modulated high-frequency voltages between the first electrodes 2A and 3A and between the second electrodes 2B and 3B respectively to cause plasma generation by discharging, and the first power supply 4A and the second power supply 4B are controlled so as not to make their voltage pulses overlap temporally with each other.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] It is the electron device manufacturing installation by which the high-frequency voltage which carried out pulse modulation is impressed to the vacuum housing which has the 1st and the counterelectrode of the 2nd pair inside, the gas induction which introduces material gas into a vacuum housing, and inter-electrode [the 1st and inter-electrode / of the 2nd pair], respectively, they are equipped with the 1st and 2nd power supply sections which carry out plasma electric discharge, and the 1st and 2nd power supply sections are controlled so that the ON time of a modulation pulse does not lap mutually.
[Claim 2] High-frequency voltage is an electron device manufacturing installation according to claim 1 which has frequency in the band of a radio wave - ultrahigh frequency.
[Claim 3] A modulation pulse is an electron device manufacturing installation according to claim 1 or 2 which whose ON time is 1 - 100 microseconds, and has OFF time in the range for 5 - 500 microseconds.
[Claim 4] A modulation pulse is the electron device manufacturing installation of any one publication of the claim 1-3 whose duty ratio is 20% or less.
[Claim 5] The voltage which consists of the process which installs a workpiece-ed in the interior inter-electrode [of the each set of the vacuum housing which has the 1st and the electrode of the 2nd pair which counters], a process which introduces material gas into a vacuum housing, and a process which impresses the high-frequency voltage which carried out pulse modulation to the 1st and inter-electrode [of the 2nd pair], respectively, and carries out plasma electric discharge, and is impressed to the 1st and inter-electrode, respectively is the electron device manufacture method controlled so that the ON time of a modulation
[Claim 6] High-frequency voltage is the electron device manufacture method according to claim 5 which has frequency in the band of a radio wave - ultrahigh frequency.
[Claim 7] A modulation pulse is the electron device manufacture method according to claim 5 or 6 which whose ON time is 1 - 100 microseconds, and has OFF time in the range for 5 - 500 microseconds.
[Claim 8] A modulation pulse is the electron device manufacture method of any one publication of the claim 5-7 that a duty ratio is 20% or less.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the suitable electron device manufacturing installation for the plasma etching system used in order to process an electron device manufacturing installation, the plasma excitation chemical-vapor-deposition equipment (henceforth plasma CVD equipment) used for the manufacture of semiconductor films, such as a hydrogenation amorphous silicon (henceforth a-Si:H), or an insulator layer in electronic industry in more detail about the method or a semiconductor device, a liquid crystal device, etc., and the electron device manufacture method.
[0002]
[Description of the Prior Art] The plasma CVD equipment which plasma-excites, decomposes material gas and deposits a thin film from a gaseous phase, or the plasma etching system used in order [the] to process a semiconductor device, a liquid crystal display element, etc. conversely is widely used for manufacture of an electron device today for the metal membrane / semiconductor film / dielectric film, or the crystal wafer.
[0003] In these manufacturing installations, in order to realize a high throughput (throughput), it is very important to process many substrates at once. Therefore, a policy, such as increasing the number of enlarging size of a reaction chamber and enlarging the electrode size of a cathode electrode and an anode electrode, and cathode electrodes and anode electrodes, is taken.
[0004] Moreover, it is also important by making processing speed of equipment high to realize a high throughput. About film deposition, the high speed and quality a-Si:H film growth technology by the short pulse and the VHF plasma CVD method are known (for example, refer to JP,7-166358,A).
[0005]
[Problem(s) to be Solved by the Invention] Although processing speed will be early made with plasma CVD equipment if electric discharge power, electric discharge frequency, etc. are made to increase, if a certain limit is exceeded, the unusual electric discharge phenomenon in which particle (powder) occurs or electric discharge takes place except the space (space in which the substrate to process is installed) to wish will occur, and desired processing will become impossible.
[0006] In order to suppress generating of particle, it is known that pulse modulation electric discharge is effective (Appl.Phys.Lett., 57.1616 (1990), and Y.Watanabe et al.). On the other hand, the electric discharge power with which unusual electric discharge begins to occur will be decided by the electric discharge frequency currently used, the size of an electrode, etc. Therefore, in order to realize the further high throughput, it is necessary to increase processing many substrates at once, i.e., the number of electrodes.
[0007] However, if two or more electrodes are installed in one space (inside of a vacuum housing) and RF power is impressed to them, the mutual interference of plasma will occur, an unusual electric discharge phenomenon becomes easy to occur, and there is a problem that the processing speed per electrode will fall, compared with the case where the number of electrodes is one.
[0008] the processing speed per electrode does not fall but this invention offers the manufacturing installation and method of boiling the mass-production efficiency of these electron devices markedly, and improving in electronic industrial fields using the a-Si:H system thin film, such as a solar battery and a liquid crystal display element, as a result, when it is made in consideration of such a situation and processes two or more substrates using two or more electrodes
[0009]
[Means for Solving the Problem] This invention impresses the high-frequency voltage which carried out pulse modulation, respectively to the vacuum housing which has the 1st and the counterelectrode of the 2nd pair inside, the gas induction which introduces material gas into a vacuum housing, and inter-electrode [the 1st and inter-electrode / of the 2nd pair], and equips them with the 1st and 2nd power supply sections which carry out plasma electric discharge, and the 1st and 2nd power supply sections offer the electron device manufacturing installation controlled so that the ON time of a modulation pulse does not lap mutually.
[0010] Moreover, the process to which this invention installs a workpiece-ed in the interior inter-electrode [of each set of the vacuum housing which has the 1st and the electrode of the 2nd pair which counters], It consists of a process which introduces material gas into a vacuum housing, and a process which impresses the high-frequency voltage which carried out pulse modulation to the 1st and inter-electrode [of the 2nd pair], respectively, and carries out plasma electric discharge. The voltage impressed to the 1st and inter-electrode [of the 2nd pair], respectively offers the electron device manufacture method controlled so that the ON time of a modulation pulse does not lap mutually
[0011]

[Embodiments of the Invention] The 1st and the counterelectrodes of the 2nd pair in this invention may be at least two pairs of counterelectrodes, and may be three or more pairs of counterelectrodes. A counterelectrode is an parallel plate electrode which faced mutually, for example.
[0012] And a workpiece-ed, for example, a wafer, is installed on one of electrodes among the counterelectrodes of each set. Usually, the electrode of the side which installs a workpiece-ed is called cathode electrode, and is grounded. In this case, a reverse electrode is called anode electrode.
[0013] The vacuum housing in this invention is a container which holds the gas ** to the pressure of about 10-1-1 Torr, when material gas is introduced into the interior. In forming an a-Si:H film as plasma CVD equipment using this equipment as material gas -- SiH4 Or Si two H6 or these gas -- CH4, C2 H6, PH3, B-2 H6, and GeH4 What added either, or added and diluted H2, or helium, Ar, Xe and Kr is used. Moreover, when forming Si oxide film, as material gas, a SiH4-N2 O system is used, for example.
[0014] furthermore -- the time of a workpiece-ed being Si as reactant gas in the case of using this equipment as a plasma etching system -- CF4, CF3 Cl, CF2 Cl2, CFCl3, CF3 Br, and CCl4 etc. -- it uses -- having -- a workpiece-ed -- SiO2 it is -- the time -- CF4, C2 F6, C3 F8, and CHF3 etc. -- it is used
[0015] Moreover, gas induction is a means to supply gas to a vacuum housing from a chemical cylinder. You may be different frequency, although it is the power supply which outputs the high-frequency voltage which carried out pulse modulation and it is desirable that it is the same frequency as for the RF output, in order that the 1st and 2nd power supply sections may make the 1st and inter-electrode [of the 2nd pair] generate plasma electric discharge.
[0016] Moreover, the frequency contains a 13.56MHz radio wave, a high RF (VHF, dozens of MHz), or ultrahigh frequency (UHF, hundreds of MHz) that what is necessary is just to be in the band of a radio wave - ultrahigh frequency.
[0017] Moreover, although the 1st and 2nd power supply sections carry out pulse modulation of the high-frequency voltage and impress it to inter-electrode, the modulation pulse is controlled so that ON time does not lap mutually. By this, even if it increases the power of plasma electric discharge, the 1st and the 2nd-pair inter-electrode plasma electric discharge do not carry out a mutual interference, therefore unusual electric discharge is prevented.
[0018] In this case, the ON time of a modulation pulse should be in the range for 1 - 100 microseconds, and OFF time should just be in the range for 5 - 500 microseconds. Moreover, if the duty ratio of pulse modulation is 20% or less, its prevention effect of unusual electric discharge is still more remarkable.
[0019]
[Example] Hereafter, based on the example shown in a drawing, this invention is explained concretely. Drawing 1 is composition explanatory drawing of an electron device manufacturing installation, and drawing 2 shows the timing chart of the modulation pulse impressed to inter-electrode [of this equipment]. This electron device manufacturing installation is used as plasma CVD equipment.
[0020] As shown in drawing 1 , the cathode electrodes 3A and 3B are arranged inside the vacuum housing 1 at anode electrode 2A and 2B of two sheets, and them and parallel. The substrates (workpiece-ed) 6A and 6B to process are installed on cathode electrode 3A and 3B. The cathode electrodes 3A and 3B are electrically grounded by the vacuum housing 1, and the potential is grand level.
[0021] Moreover, the gas inlet 7 is formed in the upper part of a vacuum housing 1, and material gas is introduced into a vacuum housing 1 through a bulb 11 and a gas inlet 7 from a bomb 10. Evacuation of the gas in a vacuum housing 1 is carried out through a main valve 8 by the vacuum pump 9.
[0022] Opening of the center of a right-and-left wall of a vacuum housing 1 is carried out electrically, it lets this opening pass, and the pulse modulation RF power generation sources 4A and 4B are connected to anode electrode 2A and 2B, respectively. In addition, anode electrode 2A and the modulation pulse train impressed to each 2B are controlled by the pulse signal delay circuit 5 so that a "on" period does not lap.
[0023] Here, the cross section with the as parallel size of a vacuum housing 1 as an electrode side is 1.6mx1.6m. The size of anode electrode 2A, 2B, and the cathode electrodes 3A and 3B is 700mm angle.
[0024] Moreover, the mixed gas of a silane and hydrogen is used as material gas. For RF frequency, the ON time of 27.12MHz and a modulation pulse is [10microsec and the duty ratio of the electric discharge parameter to be used] 20%, respectively.
[0025] Plasma electric discharge is generated between electrode 2A-6A and among electrode 2B-6B, introducing material gas into a vacuum housing 1 on such conditions, and membrane formation processing which forms an a-Si:H film on substrate 6A and 6B is performed. When the "on" period of anode electrode 2A and the modulation pulse train impressed to each 2B was piled up at this time, unusual electric discharge occurred [electric discharge power] in 500W.
[0026] However, the electric discharge (an anode electrode and cathode inter-electrode electric discharge) normal to 950W of the place and electric discharge power with which only 25micro sec shifted the "on" period of a pulse train was attained. Therefore, according to this equipment, when processing two substrates simultaneously, high-speed membrane formation can be attained, and improvement in mass-production nature can be aimed at.
[0027] Although this example explained the case where an electron device manufacturing installation was applied to plasma CVD equipment, it can apply also about the plasma dry etching system to which a plasma particle and the active species by plasma excitation ********** a film, and the same effect as the above can be done so.
[0028]
[Effect of the Invention] In applying an electron device manufacturing installation to plasma CVD equipment, when processing two or more substrates using two or more pairs of electrodes according to this invention, the processing speed per one pair of electrode does not fall, but the mass-production nature of these electron devices can be improved in electronic industrial fields

using the a-Si:H system thin film, such as a solar battery and a liquid crystal display element, as a result. When similarly a plasma particle and the active species by plasma excitation apply a film to the plasma etching system which **********s, mass-production nature, such as a liquid crystal display element, can be improved.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is composition explanatory drawing showing the example in the case of applying the electron device manufacturing installation of this invention to plasma CVD equipment.
[Drawing 2] It is the timing diagram which shows the modulation pulse shape applied to the example of this invention.
[Description of Notations]
1 Vacuum Housing
2A, 2B Anode electrode
3A, 3B Cathode electrode
4A, 4B Pulse modulation RF-electrode generation source
5 Pulse Signal Delay Circuit
6A, 6B Substrate
7 Gas Inlet
8 Main Valve
9 Vacuum Pump
10 Bomb
11 Bulb

[Translation done.]